Pakistan J. Sci. Ind. Res., Vol. 30, No. 10, October 1987

EFFECT OF SUBSTITUTION OF SUCROSE WITH LIQUID GLUCOSE ON THE QUALITY OF MANGO SQUASH

Maqbool Ahmed, Mohammad Ashraf Chaudry and Ismail Khan

Nuclear Institute for Food and Agriculture, Tarnab, Peshawar

and

Naila Samina Kaif and Nasim Habib

College of Home Economics, University of Peshawar, Peshawar

(Received July 12, 1987; revised October 6, 1987)

Replacement of sucrose with liquid glucose at 25 to 100 % levels in mango squash caused a significant increase in total acidity, significant decrease in total soluble solids (TSS) and TSS/ acid ratio, but had no significant effect on ascorbic acid content. Ascorbic acid and total acid content of mango squash decreased significantly whereas TSS and TSS/acid ratio increased markedly during a storage period of five months at room temperature (13-35°). Substitution of sucrose with liquid glucose upto 25 % did not lower the organoleptic scores of the mango squash.

Key words: Mango squash, liquid glucose and storage stability.

INTRODUCTION

Squash is the most popular non-alcoholic drink of Pakistan and other tropical countries. Optimum sugar concentration in squash is important as it can influence the degradation of preservatives [1] and retention of sensory characteristics during storage [2]. Sucrose is commonly used for the preparation of squash in Pakistan. As 40 to 50 % of squash consists of sucrose, increase in its price can adversely affect this fruit based beverage industry in Pakistan. Replacement of sucrose with some less costly sweeteners is a need of the day.

Corn sweeteners like corn syrups, maltodextrin, high fructose corn syrup etc. have found wide application as a cheaper alternative to sucrose in food products such as soft drinks, yeast leavened baked goods and canned fruits, where the main function of sugar is to provide sweetness [3]. Corn syrup is being manufactured on commercial scale but hitherto very little attention has been given to its effective use in food industry of Pakistan. The present study was undertaken to study the effect of different sucrose and liquid glucose combinations on the quality and storage stability of mango squash.

MATERIALS AND METHODS

Good quality mango fruit (Desi cultivar) was procured from the local market for the preparation of squash. After washing the fruit in running tap water, the pulp was extracted by a locally fabricated pulper and collected in stainless steel containers. The following formulation was standardized by Ahmad *et al.* [2] and used for the preparation of mango squash:

Pulp	=	100 parts
Water	=	100 "
Sugar	=	200 "
Citric acid	=	4 "

Sucrose was substituted at 0, 25, 50, 75 and 100 % levels with liquid glucose (Rafhan Maize Products Ltd. Pakistan) in the present studies. TSS and acid content of sucrose and liquid glucose used for the preparation of squash were 99 and 78 %, and 0 and 0.128 %, respectively. The pulp was diluted with water and divided into five equal lots. Each lot of diluted mango pulp was cooled thoroughly mixed with different combinations of sucrose/ liquid glucose and passed through a single-fold muslin cloth to remove coarse pulp particles. Citric acid was then added and potassium metabisulphite (350 ppm) all the samples preserved along with the treated squash samples were stored in hermatically sealed sterilized glass bottles at room temperature (13–35°) away from direct sunlight or flourescent light.

Ascorbic acid, acidity and total soluble solids (TSS) of different squash samples were determined by the stan-

dard methods of AOAC [4]. TSS and acid ratio were determined by dividing the former by the latter. Organoleptic evaluation of different squash samples for colour, flavour, taste and overall acceptability was carried out by a panel of ten judges using a numerical score method [5]. A scale of 0 to 10 was employed with 0 indicating extreme dislike and 10 representing extreme like. Data were subjected to statistical analysis for analysis of variance with least significant difference (LSD) between treatment and storage interval means determined [6].

RESULTS AND DISCUSSION

(1). *Ascorbic acid.* Effect of substitution of sucrose with liquid glucose had no significant effect on ascorbic acid content of mango squash. However, ascorbic acid content decreased significantly ($P < 0.01$) throughout the storage period of 5 months (Table 1). In the present studies retention of ascorbic acid of all squash samples was 77.51 % after 5 months of storage at room temperature ($13-35^{o}$).Results on the loss of ascorbic acid in squashes and related drinks are variable. Bender [7] found very little loss and Martin [8] reported 80 to 90 % retention of ascrobic acid in orange squash and orange juice cordials, respectively after 6 months of storage. As regards lemon squash, only about 35 % ascrobic acid was retained in 7 months storage at ambient conditions [9]. Similarly, the retention of ascorbic acid varied from 11 to 75 % in bottled and canned mango squashes [10, 11, 12], respectively. Recent studies carried out in Pakistan indicate 15 and 25 % loss of ascorbic acid in orange and mango squashes respectively [2]. Retention of ascorbic acid in fruits based beverages is affected by the type of fruit used [2], cultivar and portion of fruit employed [12], type and quantity of preservative used [8], container type [13], exposure to light [14], storage temperature [10,11] and exposure of drink to air in partially filled bottles [7]. Disagreement in the results reported by various workers could be due to these variables.

(2). *Total soluble solids and total acids.* Different liquid glucose substitution levels as well as storage periods had significant ($P < 0.01$) effective on these physico-chemical constituents of mango squash. As liquid glucose contained less TSS and more acidity than sucrose. Thus the substitution of sucrose with increasing levels of liquid glucose caused an increase in total acids and a decrease in TSS and TSS/acid ratio in mango squash (Table 1). The total acid content of mango squash decreased whereas TSS and TSS/acid ratio increased throughout the storage period of 5 months. Insoluble macro-molecules might have been degraded under acidic conditions to low molecular weight soluble entities during storage of squash samples, resulting in an increase in TSS [15].

(3). *Sensory characteristics.* Organoleptic evaluation of different samples of mango squash was carried out for colour, odour and taste at one month storage interval (Table 2). There was a gradual and significant ($P < 0.01$) decrease in the scores of all the quality characteristics studied during storage of squash for 5 months at room temperature ($13-35^{o}$).Although the substitution of sucrose

Table 1. Mean values showing the overall effect of different substitution levels of sucrose with liquid glucose and storage periods on the chemical characteristics of mango squash.

Chemical constituents	Substitution levels (%)					LSD (1 %)	Storage period (months)						LSD (1 %)
	0	25	50	75	100		0	1	2	3	4	5	
Ascorbic acid (mg/100 ml)	6.11	6.40	6.25	6.12	6.28	N.S	6.98	6.69	6.34	6.00	5.63	5.41	0.281
Total soluble Solids (TSS)	54.80	53.93	52.30	51.17	49.17	0.394	50.0	51.56	52.00	52.54	53.12	53.52	0.394
Acidity (g/100 ml)	0.90	0.97	0.99	1.07	1.07	0.102	1.34	1.29	1.22	0.79	0.69	0.65	0.093
TSS/acid (ratio)	67.52	61.17	58.10	53.03	50.99	8.43	38.21	40.10	42.92	67.31	77.59	82.80	7.069

Storage temperature = $13-35^{o}$

Table 2. Mean values showing the overall effect of different substitution levels of sucrose with liquid glucose and storage periods on the organoleptic characteristics of mango squash.

Quality characteristics	Substitution levels (%)					LSD (1 %)	Storage period (months)						LSD (1 %)
	0	25	50	75	100		0	1	2	3	4	5	
Colour (0-10)*	7.49	7.22	6.74	6.62	6.02	0.52	7.46	7.06	7.00	6.85	6.47	6.05	0.48
Odour (0-10)*	6.99	6.75	6.42	6.31	5.99	0.51	7.55	6.80	6.40	6.20	6.07	5.94	0.47
Taste (0-10)*	7.67	7.09	6.16	5.06	4.33	0.59	6.57	6.40	6.31	6.07	5.96	5.05	0.51
Overall (0-10)*	7.38	7.02	6.44	5.99	5.45	0.53	7.20	6.75	6.57	6.37	6.17	5.68	0.49

* 0 = Disliked extremely; 10 = Liked extremely; Storage temperature = 13– 35°

with liquid glucose resulted in lower sensory scores, yet the decrease was not statistically significant upto 25 % level of replacement. Corn syrups have been used in a variety of food products [3]. Starchan and Athinson [16] claimed that the replacement of sucrose by corn syrup upto 20 % gave better results in the preparation of canned cherries. Joslyn *et al.* [17] observed no flavour differences in canned peaches upto 25 % replacement level, but were usually noticeable at higher levels of replacement.

CONCLUSION

It can be concluded from present investigation that sucrose in mango squash can only be replaced upto 25 % level by liquid glucose as higher replacement levels would invariably result in quality deterioration of the product. The price of sucrose and liquid glucose is Rs. 10.0 and 9.50 per kg. respectively, on equal total solids basis. The substitution of sucrose with liquid glucose will therefore lower the price of mango squash.

REFERENCES

1. K. Vidyasagar and S.S. Arya, J. Agr. Fd. Chem., **31**, 1262 (1983).
2. M. Ahmad, M.A. Chaudry and I. Khan, The Nucleus, **23**, 45 (1986).
3. G.E. Inglett, Fd. Technol., **35**, 37 (1981).
4. AOAC Official Methods of Analysis (Association of Official Analytical Chemists, Washington, D.C., 1984), 14th ed.
5. J.K. Krum, Fd. Engg., **27**, 74 (1955).
6. R.G.D. Steel and J.H. Torrie, *Principles and Procedures of Statistics* (McGraw Hill Book Co, New York, 1980).
7. A.E. Bender, J. Sci. Fd. Agr., **9**, 754 (1958).
8. C.M. Martin, Fd. Technol. Aust., **13**, 363 (1961).
9. K.P. Palaniswamy and C.R. Muthukrishnan, Indian Fd. Packer, **28**, 37 (1974).
10. A.R. Saeed and A. El-Mubarak, Sudan J. Fd. Sci. Technol., **3**, 48 (1971).
11. A.R. Saeed and A.M. Abu Sin, Sudan J. Fd. Sci. Technol., **3**, 56 (1971).
12. A.R. Saeed, Sudan J. Fd. Sci. Technol., **4**, 46 (1972).
13. O.W. Bisset and R.E. Berry, J. Fd. Sci., **40**, 178 (1975).
14. A.A. Ahmed, G.H. Watrous, G.L. Hargrove and P.S. Dimick, J. Milk and Fd. Technol., **39**, 322 (1976).
15. I. Muhammad, M.A. Chaudry, M. Ahmad, J. Muhammad and I. Khan, The Nucleus, **23**, 15 (1986).
16. C.C. Starchan and F.E. Athinson, Fd. Technol., **9**, 518 (1955).
17. M.A. Joslyn, S.J. Leonard and E. Hinreiner, Fd. Technol., **21**, 139 A (1957).